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HOGAN & HARTSON L.L.P.
1999 AVENUE OF THE STARS
SUITE 1400
LOS ANGELES, CA 90067

| EXAMINER | |
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| SMITH, JACKSON R | |
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| 1709 | |

| SHORTENED STATUTORY PERIOD OF RESPONSE | MAIL DATE | DELIVERY MODE |
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| 3 MONTHS | 04/18/2007 | PAPER |

**Please find below and/or attached an Office communication concerning this application or proceeding.**

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

| Office Action Summary | Application No. | Applicant(s) |
|---|---|---|
| | 10/801,987 | FUKAWA ET AL. |
| | Examiner | Art Unit |
| | Jack Smith | 1709 |

-- *The MAILING DATE of this communication appears on the cover sheet with the correspondence address* --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) 1-22 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-22 is/are rejected.

7)☒ Claim(s) 3,4 and 6 is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☒ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date 3/16/04, 12/5/06.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

## DETAILED ACTION

### *Specification*

1. The disclosure is objected to because of the following informalities: several misspellings and/or typographic errors were noticed. (e.g., "non-light receivig surface" on page 19 should be replaced by "non-light receiving surface").

Appropriate correction is required.

### *Claim Objections*

2. Claims 3 and 4 are objected to because of the following informalities: minor typographical errors. The phrase "said the other elements" should be replaced with "said other elements."

Appropriate correction is required.

3. Claim 6 is objected to because of the following informalities: a logical error and/or misuse of vocabulary. In the claim, a reference is made to "solder layer" that covers "one of the surface electrode on the light receiving surface of one of the solar cell elements." The claim further states that the same solder layer covers "the back surface electrode on the non-light receiving surface of another one of the solar cell elements" such that the latter element is "adjacent thereto that is connected to the connection tabs temporally earlier than the other one." Although it seems clear from context that the author means to write that one of these elements precedes the next in a sequence of such elements, the word "temporally' refers to a sequence in time. Its use here in this claim is not appropriate. In order to examine the claim on its merits, the

preceding will be interpreted to mean that the solder layer with the higher melting point covers the surface electrode of one cell and the back electrode of an adjacent cell.

Appropriate correction is required.

### *Claim Rejections - 35 USC § 102*

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claim 1 is rejected under 35 U.S.C. 102(b) as being unpatentable over Tsuzuki et al. (US Patent 6.479,744 B1).

Tsuzuki et al. disclose solar cell elements (photovoltaic devices, 101 and 101') in Figures 5A and 5B. As Tsuzuki et al. explain in Column 10, lines 57-60, said solar cell element may be either an amorphous silicon solar cell (Figure 8) or a crystal silicon solar cell (Figure 9). As Tsuzuki et al. shown in Figure 9, the crystal silicon solar element contains a semiconductor substrate (semiconductor layers comprising a silicon substrate, 801 and 802) , an antireflective film formed on a light-receiving surface of the semiconductor substrate (anti-reflection film, 805), a surface electrode (collector electrode, 804) formed on a light-receiving surface of the semiconductor substrate and a back surface electrode (back electrode, 803) formed on a non-light receiving surface of the semiconductor substrate. Tsuzuki et al. further disclose connection tabs (metal member, 104) for interconnecting the surface electrode on the light-receiving surface

and the back surface electrode on the non-light receiving surface of the solar cell elements as shown in Figures 5A and 5B. In Column 7, lines 5-10, Tsuzuki et al. explain that said connection tabs are fixed to each of said electrodes via two layers of solder (i.e, one layer for each of the two sides of the connection tab). Further, Tsuzuki et al. explain in Column 12 lines 26-27 that the surface electrode (collector electrode, 9) may be formed of "metals such as Ti, Cr, Mo, W, Al, Ag, Ni, Cu, Sn and Pt, or alloys of any of these, and solder." That the surface electrode itself can be at least partially made of solder guarantees that the surface electrode and the solder used to join it to the connection tabs will share two or more elements. Indeed, solder is known in the art to be an alloy containing at least two metals.

### *Claim Rejections - 35 USC § 103*

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. Claims 2-4 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tsuzuki et al. as applied to claim 1 in view of Nakahara et al. (JP Patent Application Publication 2002-346788).

As to claim 2, the Tsuzuki et al. discloses all the features of claim 1 above, and discloses that the electrode contains solder in Column 12 lines 26-27, but fails to teach

the specific composition of that solder. Tsuzuki et al., then, fails to teach that one or more of the elements in the solder (and, therefore, the electrode) is Ag, and that the other elements are one or more kinds selected from Ti, P, and compounds thereof.

Nakahara et al. teach a Sn-Ag based solder alloy that is an environmentally sound (paragraphs 0003 and 0004) alternative to Pb-based solder while providing high joint dependability (paragraph 0006). The specific composition of the alloy is given in paragraph 0008, which lists both Ag and P as constituents. It would have been obvious to one of ordinary skill in the art at the time of the invention to use the solder of Nakahara et al. for fixing the connection tabs to the electrodes in the device of Tsuzuki et al. in order to render the latter environmentally sound while providing high joint dependability.

As to claim 3, the amount of P in the solder of Nakahara et al. is given in paragraph 0008 as 50-500 ppm which overlaps with the range (10-100 ppm) given in this claim. As explained in MPEP 2144.05 ("Overlap of Ranges"): "in cases where the claimed ranges overlap or lie inside ranges disclosed by the prior art a prima facie case of obviousness exists." Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to choose an amount of P in the solder of Nakahara et al. that occurs in the range specified by this claim.

As to claim 4, the composition of the solder of Nakahara et al. given in paragraph 0008 is: 3 –4 wt% Ag, 5-10% Bi and 50-500 ppm P with the balance being Sn. In this regime, there is a plurality of solder compositions having an amount of P between 0.05-5 wt %. Since the surface electrode of Tsuzuki et al. may be composed

of solder (Column 12 lines 25-28), the combination of Tsuzuki et al. and Nakahara et al. above allows for a surface electrode that is 0.05-5% P by weight.

7. Claims 5 and 6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tsuzuki et al. in view of Sakamoto (JP Patent Application Publication 2000-114416).

As to claim 5, Tsuzuki et al. disclose a solar cell module in Figures 5A and 5B comprising solar cell elements (photovoltaic devices, 101 and 101'). As Tsuzuki et al. explain in Column 10, lines 57-60, said solar cell element may be either an amorphous silicon solar cell (Figure 8) or a crystal silicon solar cell (Figure 9). As Tsuzuki et al. shown in Figure 8, the amorphous silicon solar element contains a semiconductor substrate (semiconductor layers, 703-5, 713-15, and 723-25) , a surface electrode (upper and collector electrodes, 706 and 707) formed on a light-receiving surface of the semiconductor substrate (as Tsuzuki et al. explain in Column 10, lines 65-67, light is incident on the side of the cell bounded by 706 and 707) and a back surface electrode (lower electrode, 702) formed on a non-light receiving surface of the semiconductor substrate; and connection tabs (metal member, 104) for interconnecting the surface electrode on the light-receiving surface and the back surface electrode on the non-light receiving surface of the solar cell elements as shown in Figures 5A and 5B. In Column 7, lines 5-10, Tsuzuki et al. further disclose that said connection tabs are fixed to each of said electrodes via two layers of solder (i.e, one layer for each of the two sides of the connection tab). What Tsuzuki et al. fail to teach is that the first solder layer for connecting the surface electrode to the connection tab on the light-receiving surface

and a second solder layer for connecting the back surface electrode to the connection tab on the non-light receiving surface having different melting points.

Sakamoto discloses a method for mounting a semiconductor device that improves reliability of contacts (abstract) by utilizing solders of at least two different melting points (paragraph 0008). As Sakamoto explains in paragraph 0006 and 0008, the use of solder with two melting points helps to avoid problems associated with solder re-flow at elevated temperatures and lead to a degradation of the dependability of said contacts. It would have been obvious to one of ordinary skill in the art at the time of the invention to use solder of two different melting points as taught in the method of Sakamoto for mounting the connection tab of Tsuzuki et al. in order to avoid re-flow problems at elevated temperatures. In this configuration, the first solder layer for connecting the surface electrode to the connection tab on the light-receiving surface and a second solder layer for connecting the back surface electrode to the connection tab on the non-light receiving surface would have different melting points.

As to claim 6, the combination of Tsuzuki et al. and Sakamoto requires the use of solder of different melting points to improve dependability of the contacts. Then, this is consistent with the solder layer with the higher melting point covering one connection end of the connecting member (i.e., covering the surface electrode, 706 and 707, on the light-receiving surface) and also the back surface electrode of an adjacent cell.

8. Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Tsuzuki et al., Sakamoto as applied to claim 6 and in further view of Nakahara et al.

The combination of Tsuzuki et al. and Sakamoto discloses all the features of claim 6 above, but fails to disclose that the solder layer with higher melting point is substantially free of lead.

Nakahara et al. teach a lead-free, Sn-Ag based solder alloy that is an environmentally sound (paragraphs 0003 and 0004) alternative to Pb-based solder while providing high joint dependability (paragraph 0006). The specific composition of the alloy is given in paragraph 0008, which lists both Ag and P as constituents. It would have been obvious to one of ordinary skill in the art at the time of the invention to use the solder of Nakahara et al. for fixing the connection tabs to the electrodes of the combination of Tsuzuki et al. and Sakamoto in order to render the latter environmentally sound while providing high joint dependability.

9. Claims 8-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tsuzuki et al., Sakamoto as applied to claim 5 and in further view of Okada et al. (US Patent 6,571,469).

As to claims 8 and 9, the combination of Tsuzuki et al. and Sakamoto discloses all the features of claim 5 above and further discloses that the connection tabs of Tsuzuki et al. (metal member, 104) are connected by means of a solder to a common connection line (bus bar, 102) as described in Column 7, lines 3-10. However, the combination of Tsuzuki et al. and Sakamoto fails to disclose: (1) through holes at the connection areas between the connection tabs and the surface electrodes or the back surface electrodes or (2) that the connection tabs are provided with through holes at connection areas between the connection tabs and the common connection line.

Okada et al. disclose a soldering method (Figure 26) for the manufacture of a modular board (Figure 1) with multiple electrodes. The method includes the use of through-holes (through holes, 103) in order to bond said electrodes more "securely" even "when the board is subject to warpage" (Column 1, lines 63-65 and Column 2, lines 1-10). The through-holes allow molten solder to flow freely between the two electrodes to create a more reliable contact (Column 3, lines 45-48). It would have been obvious to one of ordinary skill in the art at the time of the invention to use the soldering method along with the through holes of Okada et al. at the connection areas between the connection tabs and the surface electrodes in the combination of Tsuzuki et al. and Sakamoto above in order to bond the surface of the connection tab to the surface of the surface electrode to each other more reliably (i.e., more securely even when the electrodes are subject to warpage) by allowing molten solder to flow more freely between them. Similarly, it would also have been obvious to one of ordinary skill in the art at the time of the invention to use the soldering method along with the through holes of Okada et al. at the connection areas between the connection tabs and the connection line in the combination of Tsuzuki et al. and Sakamoto above in order to bond the surface of the connection tab to the surface of the connection line to each other more reliably (i.e., more securely even when the electrodes are subject to warpage) by allowing molten solder to flow more freely between them.

As to claim 10, the combination of Tsuzuki et al. and Sakamoto discloses all the features of claim 5 above and further discloses that the connection tabs of Tsuzuki et al. (metal member, 104) are connected by means of a solder to a common

connection line (bus bar, 102) as described in Column 7, lines 3-10. What the combination of Tsuzuki et al. and Sakamoto fails to disclose is that the common connection line is provided with through holes at connection areas between the common connection line and the connection tabs.

Okada et al. disclose a soldering method (Figure 26) for the manufacture of a modular board (Figure 1) with multiple electrodes. The method includes the use of through-holes (through holes, 103) in order to bond said electrodes more “securely” even “when the board is subject to warpage” (Column 1, lines 63-65 and Column 2, lines 1-10). The through-holes allow molten solder to flow freely between the two electrodes to create a more reliable contact (Column 3, lines 45-48). It would have been obvious to one of ordinary skill in the art at the time of the invention to use the soldering method along with the through holes of Okada et al. in the common connection line in order to bond the surface of the connection tab to the surface of the connection line to each other more reliably (i.e., more securely even when the electrodes are subject to warpage) by allowing molten solder to flow more freely between them.

9. Claims 11 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tsuzuki et al., Sakamoto as applied to Claim 5 and in further view of Mizukami et al. (US Patent 6,369,315 B1) and Okada et al.

With regard to both claims, the combination of Tsuzuki et al. and Sakamoto discloses all the features of claim 5 above but fails to disclose a terminal box or output wires used to connect the solar cell elements to the terminals of that box.

Mizukami et al. disclose a power generation system specifically for use with an array of photovoltaic modules (Figure 1). Like the apparatus of Tsuzuki et al., Mizukami et al. connect their photovoltaic array via bus bars (bus bar, 13, Figure 1). The major advantage of the system of Mizukami et al. over that of Tsuzuki et al., described in Column 5, lines 24-28 of Mizukami et al., is that its bus bars contain extensions (13b) that are connected directly to "an output fetching line" (or a line that allows the power outputted by the cells to be used by the outside world) via a terminal box (17). As Mizukami et al. explain in Column 2, lines 5-10, using said features with said type of terminal box allows the number of soldering spots in an output fetching wiring to be reduced. As shown in Figure 1 and explained in Column 5, lines 32-35, the output wires (bus bar extensions, 13b) connect the solar cell elements with the terminals (terminals, 18) of a terminal box (17) by means of solder (solder, 23). ). It would have been obvious to one of ordinary skill in the art at the time of the invention to add the bus bar extensions and the terminal box of Mizukami et al. to the modified device of Tsuzuki et al. in order to reduce the number of soldering spots in output fetching wiring. What the combination of Tsuzuki et al., Sakamoto and Mizukami et al. fails to teach, however, is either that the output wires or the terminals of the box are provided with through holes at connection areas between the terminals and the output wires.

Okada et al. disclose a soldering method (Figure 26) for the manufacture of a modular board (Figure 1) with multiple electrodes. The method includes the use of through-holes (through holes, 103) in order to bond said electrodes more "securely" even "when the board is subject to warpage" (Column 1, lines 63-65 and Column 2,

lines 1-10). The through-holes allow molten solder to flow freely between the two electrodes to create a more reliable contact (Column 3, lines 45-48). It would have been obvious to one of ordinary skill in the art at the time of the invention to use the soldering method along with the through holes of Okada et al. while providing the through holes either the output wires or the terminals of the combination of Tsuzuki et al., Sakamoto and Mizukami et al. above in order to bond the surface of the wire to the surface of the terminals to each other more reliably (i.e., more securely even when the electrodes are subject to warpage) by allowing molten solder to flow more freely between them.

10. Claims 13, 15 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tsuzuki et al. in further view of Okada et al.

As to claim 13, Tsuzuki et al. disclose a solar cell module in Figures 5A and 5B comprising solar cell elements (photovoltaic devices, 101 and 101'). As Tsuzuki et al. explain in Column 10, lines 57-60, said solar cell element may be either an amorphous silicon solar cell (Figure 8) or a crystal silicon solar cell (Figure 9). As Tsuzuki et al. shown in Figure 8, the amorphous silicon solar element contains a semiconductor substrate (semiconductor layers, 703-5, 713-15, and 723-25) , a surface electrode (upper and collector electrodes, 706 and 707) formed on a light-receiving surface of the semiconductor substrate (as Tsuzuki et al. explain in Column 10, lines 65-67, light is incident on the side of the cell bounded by 706 and 707) and a back surface electrode (lower electrode, 702) formed on a non-light receiving surface of the semiconductor substrate; and connection tabs (metal member, 104) for interconnecting the surface

electrode on the light-receiving surface and the back surface electrode on the non-light receiving surface of the solar cell elements as shown in Figures 5A and 5B. In Column 7, lines 5-10, Tsuzuki et al. further disclose that said connection tabs are fixed to each of said electrodes via solder. What Tsuzuki et al. fail to teach is that the connection tabs are provided with through holes at connection areas between the connection tabs and the surface electrodes or the back surface electrodes.

Okada et al. disclose a soldering method (Figure 26) for the manufacture of a modular board (Figure 1) with multiple electrodes. The method includes the use of through-holes (through holes, 103) in order to bond said electrodes more “securely” even “when the board is subject to warpage” (Column 1, lines 63-65 and Column 2, lines 1-10). The through-holes allow molten solder to flow freely between the two electrodes to create a more reliable contact (Column 3, lines 45-48). It would have been obvious to one of ordinary skill in the art at the time of the invention to use the soldering method along with the through holes of Okada et al. in the connection tabs of Tsuzuki et al. in order to bond the surface of the connection tabs to the surface of the surface electrodes to each other more reliably (i.e., more securely even when the electrodes are subject to warpage) by allowing molten solder to flow more freely between them.

As to claims 15 and 17, Tsuzuki et al. disclose a solar cell module in Figures 5A and 5B comprising: a plurality of solar cell elements (photovoltaic devices, 101 and 101'), connection tabs (bus bar, 102, Figure 5A) for interconnecting surface electrodes (upper and collector electrodes, 706 and 707, Figure 8) on a light-receiving surface and

back surface electrodes (lower electrode, 702, Figure 8) on a non-light receiving surface of the solar cell elements; and a common connection line (bus bar, 102, Figure 5A) to which the connection tabs are connected by means of a solder (as described in Column 7, lines 3-10). What Tsuzuki et al. fails to disclose is that the connection tabs are provided with through holes at connection areas between the connection tabs and the common connection line or that the common connection line is provided with through holes at connection areas between the common connection line and the connection tabs.

Okada et al. disclose a soldering method (Figure 26) for the manufacture of a modular board (Figure 1) with multiple electrodes. The method includes the use of through-holes (through holes, 103) in order to bond said electrodes more "securely" even "when the board is subject to warpage" (Column 1, lines 63-65 and Column 2, lines 1-10). The through-holes allow molten solder to flow freely between the two electrodes to create a more reliable contact (Column 3, lines 45-48). It would have been obvious to one of ordinary skill in the art at the time of the invention to use the soldering method along with the through holes of Okada et al. in the connection tabs of Tsuzuki et al. at connection areas between the connection tabs and the common connection line in order to bond the surface of the connection tab to the surface of the connection line to each other more reliably (i.e., more securely even when the electrodes are subject to warpage) by allowing molten solder to flow more freely between them. Similarly, it would have also been obvious to one of ordinary skill in the art at the time of the invention the soldering method along with the through holes of

Okada et al. in the common connection line Tsuzuki et al. at connection areas between the common connection line and the connection tabs in order to bond the surface of the connection tab to the surface of the connection line to each other more reliably (i.e., more securely even when the electrodes are subject to warpage) by allowing molten solder to flow more freely between them.

11. Claims 14, 16 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tsuzuki et al., Okada et al. and in further view of Nakahara et al.

As to claim 14, the combination of Tsuzuki et al. and Okada et al. above discloses all the features of claims 13, but fails to teach that the solder is substantially free of lead.

Nakahara et al. teach a lead-free, Sn-Ag based solder alloy that is an environmentally sound (paragraphs 0003 and 0004) alternative to Pb-based solder while providing high joint dependability (paragraph 0006). The specific composition of the alloy is given in paragraph 0008, which lists both Ag and P as constituents. It would have been obvious to one of ordinary skill in the art at the time of the invention to use the solder of Nakahara et al. for fixing all connections, including the connection areas of the connection tabs and electrodes, in the modified device of Tsuzuki et al. above in order to render said device environmentally sound while providing high joint dependability.

As to claims 16 and 18, the combination of Tsuzuki et al. and Okada et al. above discloses all the features of claims 15 and 17 above and that the connection tabs (bus bar, 102, Figure 5A of Tsuzuki et al.) are connected to the connection line (bus bar, 102,

Figure 5A of Tsuzuki et al.) by means of a solder (as described in Column 7 lines 3-10 of Tsuzuki et al.). What the combination of Tsuzuki et al. and Okada et al. fails to disclose is that the solder is substantially free of lead.

Nakahara et al. teach a lead-free, Sn-Ag based solder alloy that is an environmentally sound (paragraphs 0003 and 0004) alternative to Pb-based solder while providing high joint dependability (paragraph 0006). The specific composition of the alloy is given in paragraph 0008, which lists both Ag and P as constituents. It would have been obvious to one of ordinary skill in the art at the time of the invention to use the solder of Nakahara et al. for fixing all connections, including for fixing the connection tabs to the connection line, in the modified device of Tsuzuki et al. above in order to render said device environmentally sound while providing high joint dependability.

12. Claims 19 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mizukami et al. in view of Okada et al.

With regard to both claims, Mizukami et al. disclose a solar cell module (photovoltaic module, M, Figure 1); solar cell elements (photovoltaic cells, 12); output wires (bus bars, 13, and bus bar extensions, 13b) connected to the solar cell elements (as shown in Figure 1 and described in Column 5 lines 28-30) and a terminal box (terminal box, 17) including terminals (terminals, 18) to which the output wires (13b) are connected as shown in Figure 1. What Mizukami et al. fail to provide, however, is that either the output wires or the terminals are provided with through holes at connection areas between the wires and the terminals.

Okada et al. disclose a soldering method (Figure 26) for the manufacture of a modular board (Figure 1) with multiple electrodes. The method includes the use of through-holes (through holes, 103) in order to bond said electrodes more "securely" even "when the board is subject to warpage" (Column 1, lines 63-65 and Column 2, lines 1-10). The through-holes allow molten solder to flow freely between the two electrodes to create a more reliable contact (Column 3, lines 45-48).

It would have been obvious to one of ordinary skill in the art at the time of the invention to use the soldering method along with the through holes of Okada et al. to either the output wires or the terminals of Mizukami et al. above in order to bond the surface of the wire to the surface of the terminals to each other more reliably (i.e., more securely even when the electrodes are subject to warpage) by allowing molten solder to flow more freely between them.

13. Claims 20 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mizukami et al. and Okada et al. as applied to claims 19 and 21 above and in further view of Nakahara et al.

The combination of Mizukami et al. and Okada et al. discloses all the features of claims 19 and 21 above and Mizukami et al. further discloses that the output wires are connected to the terminals via solder (solder, 23) in Column 5, lines 32-35. What the combination of Mizukami et al. and Okada et al. fails to teach, however, is that the solder is substantially free of lead.

Nakahara et al. teach a lead-free, Sn-Ag based solder alloy that is an environmentally sound (paragraphs 0003 and 0004) alternative to Pb-based solder while providing high joint dependability (paragraph 0006). The specific composition of the alloy is given in paragraph 0008, which lists both Ag and P as constituents. It would have been obvious to one of ordinary skill in the art at the time of the invention to use the solder of Nakahara et al. for connecting the output wires to the terminals in the combination of Mizukami et al. and Okada et al. in order to render the latter environmentally sound while providing high joint dependability.

***Conclusion***

14. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jack Smith whose telephone number is (571) 272-9814. The examiner can normally be reached on 7:30 a.m. - 5:00 p.m., Mon - Fri.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Alexa Neckel can be reached on (571) 272-1446. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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JRS

Alexa Neckel
ALEXA D. NECKEL
SUPERVISORY PATENT EXAMINER